

We claim:

1 1. A method for sending data through a Fibre Channel switch, the Fibre Channel switch
2 comprising a plurality of small switches, the data having a source and a destination, comprising:
3 receiving the data from the source at a first small switch;
4 choosing a first virtual channel from a set of possible virtual channels, each virtual
5 channel of the set of possible virtual channels being available for use with
6 general data flow;
7 adding information identifying the first virtual channel to the data; and
8 sending the data and the information identifying the first virtual channel from the first
9 small switch to a second small switch.

1 2. The method of claim 1, wherein the Fibre Channel switch further comprises a
2 processor connected to each of the plurality of small switches.

1 3. The method of claim 1, wherein:
2 the data is a data frame;
3 the information identifying the first virtual channel is added to an inter-frame fill
4 word; and
5 the inter-frame fill word is sent from the first small switch to the second small switch
6 prior to the data frame.

1 4. The method of claim 1, wherein the data has a priority level, each virtual channel has a
2 priority level, and the priority levels of the data and each virtual channel within the set of
3 possible virtual channels is the same.

1 5. The method of claim 1, wherein the first virtual channel is chosen based on the source
2 of the data.

1 6. The method of claim 1, wherein the first virtual channel is chosen based on the
2 destination of the data.

1 7. The method of claim 1, wherein:

2 the first small switch has a set of source ports capable of connecting to external
3 devices;

4 the data is received at the first small switch from the source through a first source port
5 of the set of external ports; and

6 the first virtual channel is chosen from the set of possible virtual channels based on
7 the identity of the first source port.

1 8. The method of claim 7, wherein:

2 the number of virtual channels in the set of possible virtual channels is equal to or
3 greater than the number of source ports in the set of source ports;

4 each source port is associated with at least one virtual channel from the set of possible
5 virtual channels; and

6 the first virtual channel is associated with the first source port.

1 9. The method of claim 8, wherein each virtual channel is associated with no more than
2 one source port.

1 10. The method of claim 7, wherein:

2 the number of virtual channels in the set of possible virtual channels is equal to the
3 number of source ports in the set of source ports;

4 each source port is associated with one virtual channel from the set of possible virtual
5 channels; and

6 the first virtual channel is associated with the first source port.

1 11. The method of claim 7, further comprising storing the received data in a buffer
2 associated with the first source port.

1 12. The method of claim 1, further comprising:

2 determining the destination of the data;

3 retrieving an identity of a port from a routing table, the port identity being associated
4 with the destination in the routing table; and
5 wherein the data and the information identifying the first virtual channel is sent from
6 the first small switch to the second small switch through the port.

1 13. The method of claim 12, wherein:

2 the Fibre Channel switch further comprises a processor connected to each of the
3 plurality of small switches; and
4 the processor sends at least one routing table entry to each of the plurality of small
5 switches, each of the small switches storing the entry in the routing table, the
6 entry comprising a destination and a port identity associated with the
7 destination.

1 14. The method of claim 1 further comprising:

2 receiving the data from the first small switch at the second small switch;
3 choosing a second virtual channel from a set of possible virtual channels;
4 adding information identifying the second virtual channel to the data; and
5 sending the data and the information identifying the second virtual channel from the
6 second small switch to a third small switch

1 15. The method of claim 14, wherein each of the set of possible virtual channels has a
2 respective buffer and further comprising storing the data in the second small switch in a buffer
3 associated with the first virtual channel.

1 16. The method of claim 14, wherein the second virtual channel is chosen from the set of
2 possible virtual channels based on the destination.

1 17. The method of claim 14, wherein the data includes information identifying the
2 destination, further comprising:
3 determining an identity of the destination from the received data; and

4 wherein choosing the second virtual channel comprises looking up the identity of the
5 destination in a routing table, and choosing as the second virtual channel the
6 virtual channel associated with the destination in the routing table.

1 18. The method of claim 14, wherein:

2 the Fibre Channel switch further comprises a processor connected to each of the
3 plurality of small switches; and

4 the processor sends at least one routing table entry to each of the plurality of small
5 switches, each of the small switches storing the entry in the routing table, the
6 entry comprising a destination and a virtual channel associated with the
7 destination.

1 19. The method of claim 14, further comprising:

2 determining the destination of the data;

3 retrieving an identity of a port from a routing table, the port identity being associated
4 with the destination in the routing table; and

5 wherein the data and the information identifying the second virtual channel is sent
6 from the second small switch to the third small switch through the port.

1 20. The method of claim 14, further comprising:

2 receiving the data from the second small switch at the third small switch; and

3 sending the data from the third small switch to the destination.

1 21. The method of claim 20, further comprising storing the data in the third small switch
2 in a buffer associated with the second virtual channel.

1 22. The method of claim 20, further comprising:

2 determining the destination of the data;

3 retrieving an identity of a port from a routing table, the port identity being associated
4 with the destination in the routing table; and

5 wherein the data is sent from the third small switch to the destination through the
6 identified port.

1 23. A Fibre Channel small switch operable to receive and output data using virtual
2 channels, comprising:

3 a plurality of ports;

4 a plurality of source ports capable of connecting to external devices, the plurality of
5 source ports being a subset of the plurality of ports;

6 a plurality of buffers, each buffer being associated with a respective virtual channel;
7 and

8 logic operable to determine an identification of a destination of the data and to
9 determine an identification of a virtual channel available for general data flow
10 on which to output received data.

1 24. The method of claim 23, wherein the identification of the virtual channel available
2 for general data flow on which to output received data is determined based on the source of the
3 data.

1 25. The method of claim 23, wherein the identification of the virtual channel available
2 for general data flow on which to output received data is determined based on the destination of
3 the data.

1 26. The small switch of claim 23, further comprising a memory storing an identity of a
2 virtual channel associated with each source port and available for general data flow.

1 27. The small switch of claim 26, the logic further being operable to, in response to the
2 small switch receiving the data through a first source port of the plurality of source ports, retrieve
3 a first virtual channel identifier identifying a first virtual channel associated with the first source
4 port from the memory, add to the data information identifying the first virtual channel, and
5 output the data and the information identifying the first virtual channel.

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1 28. The small switch of claim 23, the logic further being operable to, in response to the
2 small switch receiving the data from another small switch, retrieve information identifying a first
3 virtual channel from a routing table, add to the data the information identifying the first virtual
4 channel, and output the data and the information identifying the first virtual channel.

1 29. The small switch of claim 28, wherein the first virtual channel is associated with a
2 destination of the data.

1 30. The small switch of claim 28, wherein:
2 the data is a data frame;
3 the information identifying the first virtual channel is added to an inter-frame fill
4 word; and
5 the inter-frame fill word is output preceding the output of the data frame.

1 31. The small switch of claim 23, the logic further being operable to, in response to
2 receiving the data and determining the identification of a virtual channel used with the received
3 data, storing the data in a buffer associated with the virtual channel.

1 32. A method for processing a data frame at a small Fibre Channel switch, the small
2 Fibre Channel switch having a plurality of ports, comprising:
3 receiving the data frame through a first one of the plurality of ports;
4 determining a virtual channel of a plurality of virtual channels available for general
5 data flow on which the data frame was received; and
6 storing the data frame in one of a plurality of buffers, the buffer being associated with
7 the virtual channel on which the data frame was received.

1 33. The method of claim 32, wherein the small Fibre Channel switch is within a larger
2 Fibre Channel switch, the larger Fibre Channel switch comprising a plurality of small Fibre
3 Channel switches.

1 34. The method of claim 33, wherein the larger Fibre Channel switch further comprises a
2 processor connected to each of the plurality of small Fibre Channel switches.

1 35. The method of claim 32, wherein the buffer is further associated with the port
2 through which the data frame was received.

1 36. The method of claim 32, wherein determining the identity of the virtual channel used
2 to send the data frame comprises retrieving the identity of the virtual channel from an inter-frame
3 fill word received by the small Fibre Channel switch prior to receiving the data frame.

1 37. The method of claim 32, further comprising:

2 determining an identity of a destination of the data frame;

3 determining which port to output the data frame through;

4 determining an identity of a virtual channel to output the data frame on;

5 adding information that identifies the virtual channel on which the data frame is
6 output;

7 outputting the data frame and the added information through the determined port.

1 38. The method of claim 37, wherein the identity of the virtual channel to output the data
2 frame on is determined based on the source of the data.

1 39. The method of claim 37, wherein the identity of the virtual channel to output the data
2 frame on is determined based on the destination of the data.

1 40. The method of claim 37, wherein determining through which port to output the data
2 frame comprises retrieving the identity of the port associated with the identity of the destination
3 of the data frame from a routing table stored in a memory of the small switch.

1 41. The method of claim 37, wherein determining the identity of the virtual channel to
2 output the data frame on comprises retrieving the identity of the virtual channel associated with

3 the identity of the destination of the data frame from a routing table stored in a memory of the
4 small switch.

1 42. The method of claim 41, wherein the small Fibre Channel switch is within a larger
2 Fibre Channel switch, the larger Fibre Channel switch comprising a plurality of small Fibre
3 Channel switches.

1 43. The method of claim 42, wherein the larger Fibre Channel switch further comprises a
2 processor connected to each of the plurality of small Fibre Channel switches.

1 44. The method of claim 43, further comprising:

2 sending a routing table entry from the processor to the small Fibre Channel switch,
3 the entry comprising the destination and a virtual channel identity associated with
4 the destination; and

5 storing the routing table entry in the routing table stored in the memory of the small
6 Fibre Channel switch.

1 45. The method of claim 37, wherein:

2 adding information that identifies the virtual channel on which the data frame is
3 output comprises adding the identity of the virtual channel to an inter-frame
4 fill word associated with the data frame; and

5 outputting the data frame and the added information through the determined port
6 comprises outputting the inter-frame fill word and then outputting the data
7 frame.

1 46. A Fibre Channel switch operable to receive and output data using virtual channels,
2 comprising:

3 a plurality of small switches, each small switch comprising:

4 a memory; and

5 a plurality of ports;

6 a plurality of internal ports capable of connecting to other small switches, the
7 plurality of internal ports being a subset of the plurality of ports;
8 a plurality of buffers, each buffer being associated with a respective virtual
9 channel;
10 a memory storing an identity of a virtual channel associated with each source port
11 and available for general data flow; and
12 logic operable to determine an identification of a destination of the data and to
13 determine an identification of a virtual channel on which to output
14 received data;
15 a processor connected to each of the plurality of small switches;
16 wherein each small switch is connected to a subset of the plurality of small switches
17 via internal ports; and
18 wherein at least a subset of the plurality of small switches are each connectable to an
19 external device via external ports which comprise a subset of the plurality of
20 ports.

1 47. The small switch of claim 46, wherein the processor sends at least one routing table
2 entry to each of the plurality of small switches, each of the small switches storing the entry in the
3 routing table, the entry comprising a destination and a virtual channel associated with the
4 destination.

1 48. The method of claim 46, wherein the identification of the virtual channel available
2 for general data flow on which to output received data is determined based on the source of the
3 data.

1 49. The method of claim 46, wherein the identification of the virtual channel available
2 for general data flow on which to output received data is determined based on the destination of
3 the data.